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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SHIBLY S. AHMED,
HAIHONG WANG,
and BIN YU

Appeal 2007-4186
Application 10/602,061
Technology Center 1700

Decided: February 7, 2008

Before CHARLES F. WARREN, CATHERINE Q. TIMM, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 11-15 and 21-29. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

I. BACKGROUND

The invention relates to a method of manufacturing a semiconductor device, specifically, a double-gate device (Specification ¶ 0001). Claim 11 is illustrative of the subject matter on appeal:

11. A method of manufacturing a semiconductor device, comprising:
 - forming a fin structure on an insulating layer, the fin structure including a first side surface, a second surface, and a top surface and having a thickness ranging from about 300 Å to about 1500 Å;
 - forming source and drain regions at ends of the fin structure;
 - depositing a gate material over the fin structure to a thickness ranging from about 300 Å to about 1500 Å, the gate material surrounding the top surface and the first and second side surfaces;
 - etching the gate material to form a first gate electrode and a second gate electrode on opposite sides of the fin; and
 - planarizing the deposited gate material proximate to the fin.

Appellants request review of the sole rejection maintained by the Examiner, namely, the rejection of claims 11-15 and 21-29 under 35 U.S.C. § 103(a) over Mathew (US 2003/0151077 A1 published Aug. 14, 2003) in view of Gambino (US 6,689,650 B2 issued Feb. 10, 2004).¹

¹ Appellants request review of the rejection of claim 11 even though this claim is not listed in the Examiner's statement of rejection. As Appellants treat this claim as rejected and both Appellants and the Examiner respond to arguments directed to that claim (Br. 5-10; Ans. 5-7), we include claim 11 in our review of the rejection.

II. DISCUSSION

There is no dispute that Mathew describes a method of manufacturing a semiconductor device including forming the fin structure, gate material layer, and other layers required by the claims. Nor is there any dispute that while Mathew describes forming the same structures and layers of materials as claimed, Mathew is silent as to the thicknesses of those various structures and layers.

The Examiner determines that:

[i]t would have been obvious to one of ordinary skill in the art at the time of the invention to form the gate dielectric or gate material to the thickness range claimed, to form a working semiconductor device, since it has been held that where the general conditions of a claim are disclosed in prior art, discovering the optimum or working ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

(Ans. 4).

Appellants contend that because Mathew does not disclose any working ranges or values associated with the thicknesses of the variously disclosed structures and layers, Mathew cannot be fairly construed to suggest forming those structures and layers to the claimed thicknesses absent impermissible hindsight (*see, e.g.*, Br. 9).

While Appellants argue various claims separately, the arguments are such that the issue arising for claims 11, 13-15, 21, 23-26, and 28-29 is essentially the same for all these claims: Given that Mathew describes forming a semiconductor device having the fin structure and layers required by the claims at issue, would it have been within the capabilities of one of ordinary skill in the art to have performed the experimentation necessary to

determine the optimum or workable thicknesses for the fin structure and layers such that that artisan could form a working semiconductor device?

We answer that question in the affirmative.

1 “[A] prior art reference must be ‘considered together with the knowledge of one of ordinary skill in the pertinent art.’” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In an obviousness analysis, the proper focus is on evidence of what was known before the time of invention, and the analysis must not unduly constrain the breath of knowledge available to one of ordinary skill in the art. *In re Translogic Tech.*, 504 F.3d 1249, 1260 (Fed. Cir. 2007). An improvement in the art is obvious if “it is likely the product not of innovation but of ordinary skill and common sense.” *KSR Int’l v. Teleflex Inc.*, 127 S. Ct. 1727, 1742 (2007). Optimization of a variable which is recognized in the prior art to be a result effective variable would ordinarily be within the skill in the art. *In re Boesch*, 617 F.2d 272, 276 (CCPA 1980); *see also In re Aller*, 220 F.2d 454, 456 (CCPA 1955) (“where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”).

In the present case, Mathew describes forming a semiconductor device having the fin structure and layers required by Appellants’ claims. The structure and layers have the same functions as those of Appellants’ device. It follows that the fin structure and layers must have some thickness, although the thickness is not disclosed in the reference. In order to make and use the semiconductor device, one of ordinary skill in the art would necessarily have to perform routine experimentation or otherwise determine, based on common knowledge in the art, the workable or optimal thicknesses

which would allow the structures and layers to perform their designated functions. The fact that Mathew does not disclose the thicknesses of these structures and layers, supports, rather than detracts from, the Examiner's findings and conclusion of obviousness: The omission leads to a presumption that these thicknesses were readily determinable through routine experimentation, i.e., it was within the capabilities of those of ordinary skill in the semiconductor art. The reference does, after all, speak to those of skill in the art.

It is well settled that the question is not whether the reference discloses a range for the variable at issue, but whether determining the range to use was within the capabilities of one of ordinary skill in the art. *See In re Huang*, 100 F.3d 135, 139 (Fed. Cir. 1996) ("This court and its predecessors have long held, however, that even though applicant's modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within the capabilities of one skilled in the art, unless the claimed ranges 'produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art.'" quoting *In re Aller*, 220 F.2d 454, 456 (CCPA 1955) and citing *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990)).

Appellants further contend that the claimed ranges enable the method to achieve particular advantages with respect to manufacturing a semiconductor device, such as advantages associated with good short channel behavior, citing paragraph 40 of the Specification (Br. 9). However, we agree with the Examiner that the Specification fails to provide evidence that good short channel behavior arises due to the use of the claimed thickness ranges (Ans. 6). Nor do Appellants provide evidence that the

“good short channel behavior” would have been unexpected by those of ordinary skill in the art. “[A]ny superior property must be *unexpected* to be considered as evidence of non-obviousness.” *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1371 (Fed. Cir. 2007).

Appellants have neither shown that the experimentation for determining the necessary thicknesses was beyond the capabilities of the ordinary artisan, nor shown that they obtain an unexpected result.

In the absence of evidence to the contrary, we determine that the evidence supports the Examiner’s determination that it would have been within the capabilities of one of ordinary skill in the art to have performed the experimentation necessary to determine the optimum or workable thicknesses for the fin structure and layers such that that artisan could form a working semiconductor device.

The totality of the evidence weighs in favor of a conclusion of obviousness.

With respect to claims 11, 22, and 27, Appellants also contend that the motivation relied upon for combining the teachings of Mathew and Gambino does not satisfy the requirements of 35 U.S.C. § 103(a) because the alleged motivation is merely a conclusory statement providing an alleged benefit.

There is no dispute that Mathew describes forming source and drain regions at the ends of the fin structure as claimed (e.g., claim 11). The Examiner relies upon Gambino for its teaching of annealing to activate source/drain regions. According to the Examiner, “it would have been obvious to one of ordinary skill in the art at the time of the invention to combine Gambino with Mathew, because the annealing activates the source/drain regions of the device.” (Ans. 4).

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The issue that arises is: Have Appellants shown that the evidence fails to adequately support the Examiner's finding of a reason to combine annealing with a process of forming a semiconductor device as taught by Mathew?

As a first matter, we note that claim 11 is not limited to the annealing step. Therefore, the issue is irrelevant with regard to this claim.

The issue is relevant with regard to claims 12, 22, and 27, however. For these claims, we answer the question in the negative.

Gambino explicitly states that annealing the doped regions forms activated source/drain diffusion regions (Gambino, col. 6, l. 67 to col. 7, l. 4). Gambino, therefore, provides sufficient evidence supporting the Examiner's finding of a reason to combine.

III. DECISION

The Examiner's decision is affirmed.

IV. TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal maybe extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

PL Initials
sld

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